

Community Cadence to Unlock the Keck Planet Finder's Full Science Potential

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Precise Doppler studies of extrasolar planets require fine-grained control of observational cadence, i.e. the timing of and spacing between observations. This enables optimal sampling of planetary and stellar activity signals, spanning hours to decades. Achieving acceptable cadence at classical observatories has been a challenge for the past three decades. As next-generation Doppler instruments achieve systematic errors well below 1 m/s, control of observational cadence will become even more critical given its central role in stellar activity mitigation techniques. One such instrument is the Keck Planet Finder (KPF) with an engineered instrumental stability of ~ 30 cm/s that achieved first light at W. M. Keck Observatory (WMKO) in November 2022. We present a novel scheduling framework called 'Community Cadence' which balances the cadence needs of KPF with WMKO's existing classical operations model. For a set of observing programs and allocated nights, our software seeks to determine the optimal timing and ordering of ~ 1000 observations within a given observing semester. This corresponds to $\sim 1000!$ or $\sim 10^{3000}$ possible orderings. We achieve a near-optimal solution in several minutes using a hierarchical Integer Linear Programming (ILP) framework. ILP solvers are used throughout the business operations and logistics sciences to solve high-dimensional optimization subject to large numbers of constraints.